

DOE/OE Transmission Reliability Program

Reliability Standards Analysis and Assessment

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Reliability Standards Analysis and Assessment

Objective:

Perform analysis to assess grid performance and standards development

- Perform grid reliability metrics analysis using data collected in CERTS applications as requested by the Resources Subcommittee
- Analyze collected data to assess reliability performance at different levels – Interconnection, Reliability Coordinator, Balancing Authority
- Perform analysis, testing, and monitoring of current and proposed reliability standards

Analysis Presented to and Used by NERC committees/groups
(Resources Subcommittee and RS-Frequency Working Group)



Reliability Standards Analysis and Assessment

4 Research Tasks:

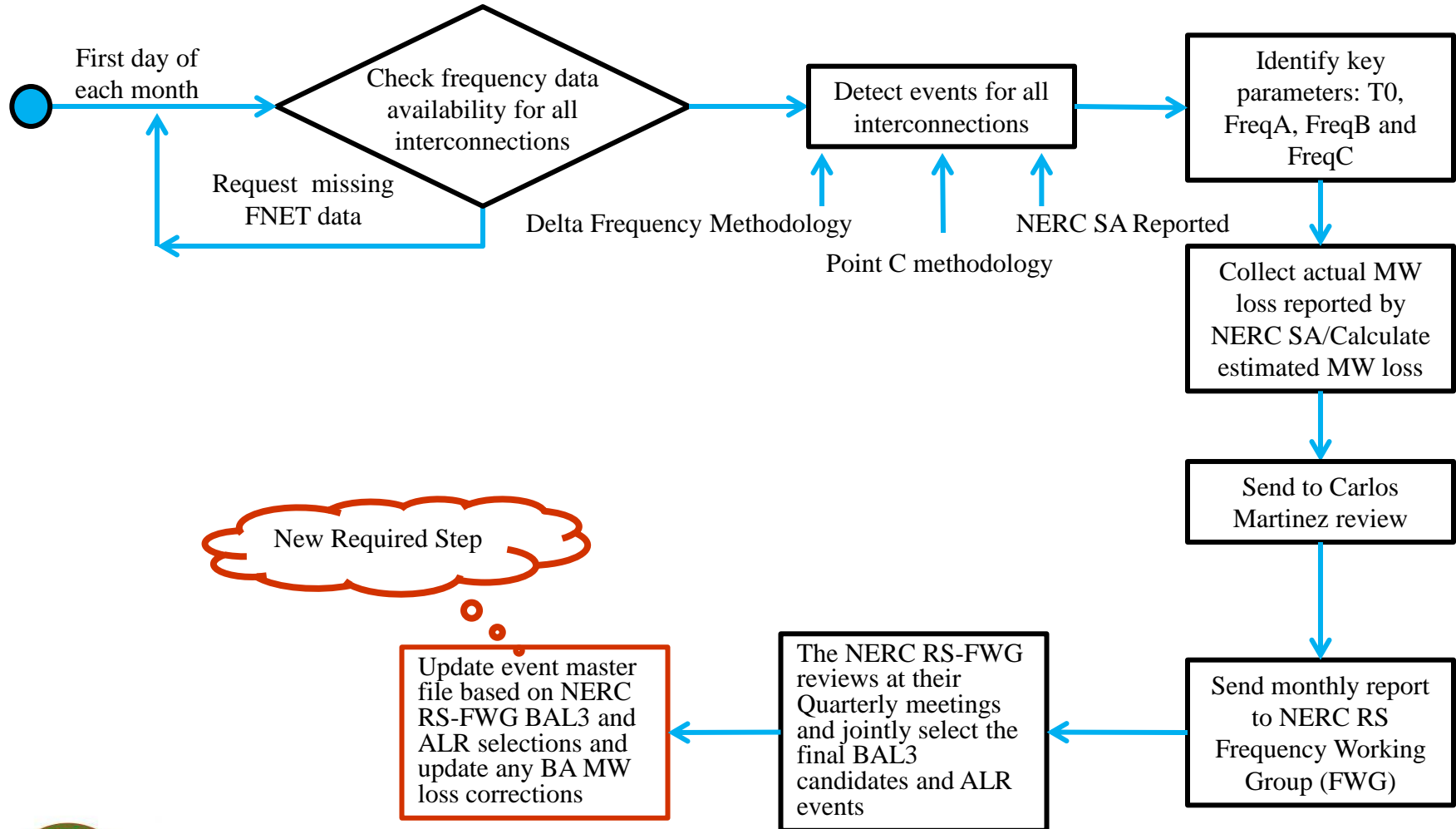
- Monthly frequency response event collection and analysis
- Provide quarterly frequency control performance report and time error correction report for all four interconnections
- Interconnections 2014 Annual Grid Reliability Performance Analysis and Report (**Final Report, will retire**)
- Monthly Frequency Device Check

2 Retired Research Tasks:

- Monthly BAAL Reports
 - Reported to Balancing Authority ACE Limit Standard Drafting Team
 - Performed analysis of the Balancing Authority ACE Limit (BAAL) for the three interconnections using the Resource Adequacy application database, and manually prepare monthly reports to support the BAAL Proof-of-Concept Field Trial Project
- Prepare Eastern Interconnection Frequency Statistics Report
 - Reported to NERC BARC 2 (BAL Periodic Review Team)



Frequency Response Event Collection and Analysis 8 Steps Process



EPG acknowledges the collaborative effort of Mr. Carlos Martinez at Advanced Systems Researchers in the preparation and production of the monthly summary reports

Frequency Response Event Collection and Analysis Results and Use of Research

- A monthly report for each frequency event with event details (A, B, C values, MW loss) is prepared and submitted to the NERC RS-FWG
- These monthly summary reports are posted on the NERC RS website under “Candidate Frequency Events”
- The NERC RS-FWG reviews the submitted reports at their Quarterly meetings and jointly select the final candidate events that BAs will use to measure their yearly Frequency Response performance
- The current process and methodologies have been accepted and approved by the NERC RS as being effective in identifying candidate events for setting frequency bias for Reliability Standard BAL-003
- Event thresholds for each Interconnection are monitored for effectiveness in detecting events and possible changes

Next Steps:

- EPG will continue to work closely with CERTS, Mr. Carlos Martinez (ASR) and the NERC RS-FWG to detect, capture and analyze all significant frequency events for all interconnections
- The current methodologies and thresholds will continue to be monitored and refined/modified as necessary
- EPG will work with Mr. Carlos Martinez to re-evaluate the estimated MW loss parameters since the frequency response as the percentage of yearly frequency bias changes



Frequency Response Event Collection and Analysis

2014 Counts and Calculated Frequency Response Summary

(Eastern Interconnection Example)

2014 Event Type	Detected Event Count	Additional Low Event Count	Additional NERC SA Reported Event Count	Total Event Count
Candidates Events	172	37	54	263
ALR Events	40	5	2	47
BAL3 Events	30	0	0	30

2014 Events Type	Total Event Count	Event Count with available MW Loss	2014 Calculated Frequency Response (MW/0.1Hz)
Candidates Events	263	138	2524
ALR Events	47	47	2647
BAL3 Events	30	29	2643



Interconnections 2014 Annual Grid Reliability Performance Analysis and Report (Final Report)

On an annual basis, EPG uses the NERC ACE and Frequency data to analyze several key grid reliability metrics and prepare a grid performance summary report for submittal to the NERC Resource Subcommittee for their review and assessment of the reliability performance at the interconnection level

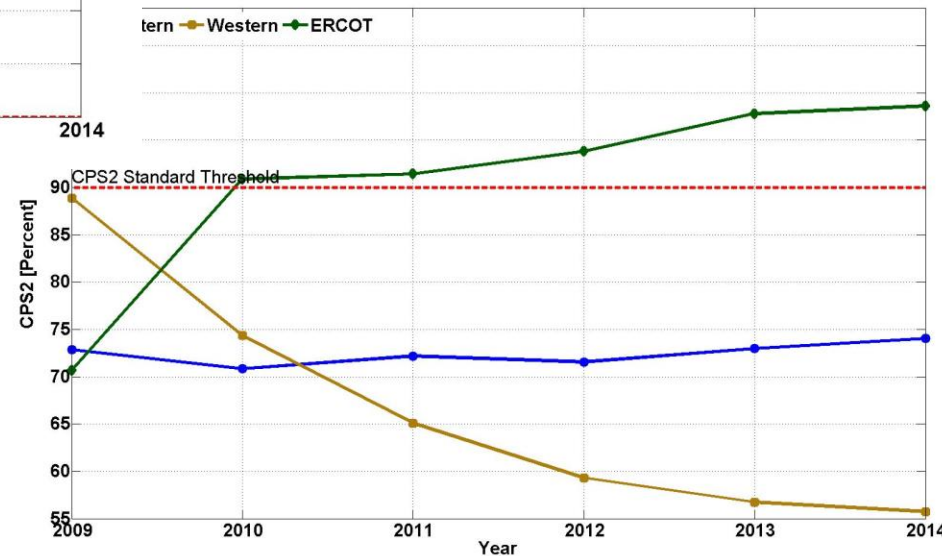
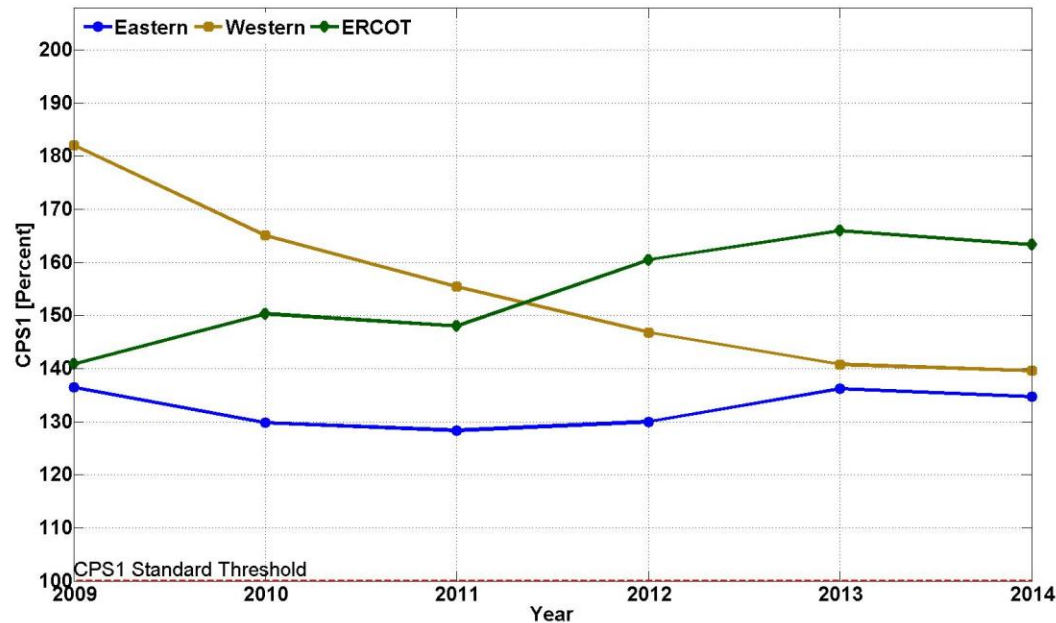
Results and Conclusion:

- Interconnections CPS1 and CPS2 Trend:
 - All three Interconnections operated above CPS1 threshold
 - Eastern and Western operated below CPS2 threshold; ERCOT operated above CPS2 threshold (ERCOT is exempted from CPS2)
 - Graph for 6-years attached
- Number of Events when Frequency > FTL Low/High Limits:
 - FTL Low limit – Eastern, Western and ERCOT decreased
 - FTL High limit – Eastern increased, Western decreased, ERCOT no change

Intercon.	2014				2013			
	Performance Metrics for Secondary Control				Performance Metrics for Secondary Control			
	CPS1	CPS2	Number of Low FTLs	Number of High FTLs	CPS1	CPS2	Number of Low FTLs	Number of High FTLs
Eastern	135	74	330	243	136	73	332	165
Western	140	56	87	37	141	57	89	62
ERCOT	163	99	60	4	166	98	80	4

Interconnections 2014 Annual Grid Reliability Performance Analysis and Report Interconnections (Highlights)

CPS1 and CPS2 6-Year Trend



Quarterly Frequency Performance Control Report

- On an quarterly basis, EPG uses the 1-minute NERC frequency data to prepare frequency control performance report for submittal to the NERC Resources Subcommittee for their review
 - Monthly CPS1, CSP2,
 - Yearly frequency deviation profile
 - Last 6 years frequency histogram
 - Hourly average of frequency deviation
 - Daily performance for RMS1, RMS10 and RMS60 of frequency deviation
 - Yearly RMS1 and RMS10 Profile of frequency deviation
 - Daily RMS1 of frequency deviation
 - Daily average of frequency deviation
- Quarterly Time Error Report

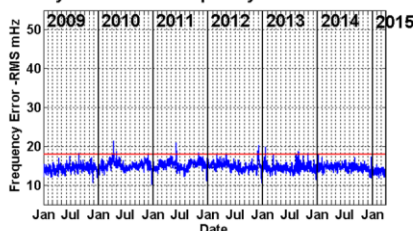


2015 First Quarter Frequency Control Performance Report

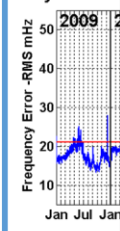
Yearly Frequency Deviation Profile, Daily RMS1 of Frequency Deviation and WECC Time Error Statistics 2015 Summary

Daily RMS1 of Frequency Deviation

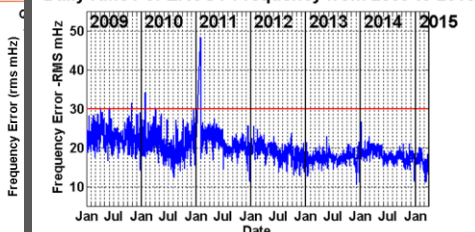
Daily RMS1 of EI Frequency from 2009 to 2015



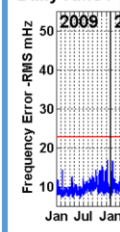
Daily RMS1 of



Daily RMS1 of ERCOT Frequency from 2009 to 2015



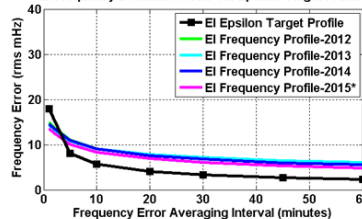
Daily RMS1 of



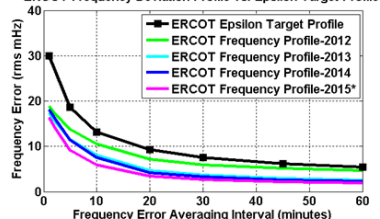
Yearly Frequency Deviation Profile

Yearly RMS1, RMS5, RMS10, RMS20, RMS30, RMS45, RMS60

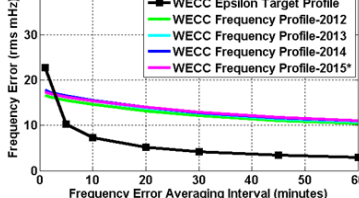
EI Frequency Deviation Profile vs. Epsilon Target Profile



ERCOT Frequency Deviation Profile vs. Epsilon Target Profile



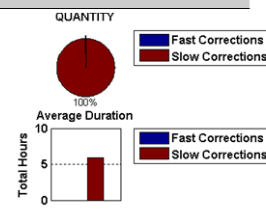
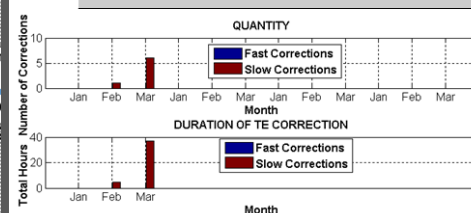
WECC Epsilon Target Profile



WECC Time Error Statistics 2015 Summary

Annual Totals (YTD)

Total Number of Time Error Corrections	7
"Fast" Time Error Corrections	0
"Slow" Time Error Corrections	7
Net Total Duration of TE Correction (Hrs)	41.45 Hours
"Fast" Time Error Corrections	0.0 Hours
"Slow" Time Error Corrections	41.5 Hours
Average Duration of Time Error Corrections(Hrs)	5.92 Hours
"Fast" Time Error Corrections	0.0
"Slow" Time Error Corrections	5.92
Actual "Time Error" Correction Achieved	48.86 Seconds 0.8 minutes



Summary and Next Steps

Frequency Response Event Collection and Analysis

- EPG will continue to work closely with CERTS, Carlos Martinez(ASR) and the NERC RS-FWG to detect, capture and analyze all significant frequency events for all interconnections
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NERC Interconnections 2014 Annual Reliability Performance Analysis and Report (Final)

- The 2014 Annual Grid Reliability Performance Report for the Eastern, WECC, and ERCOT interconnections has been completed and submitted to the NERC Resources Subcommittee
- Report was submitted on March 17 2015, and result was presented in NERC-RS meeting on April 23, 2015

Quarterly report is prepared and presented at quarterly NERC–RS meeting

Risks and Challenges:

- Availability of quality data reliably and timely
- Consensus on methodology to be used and its application

Next Steps:

- Continuing support of this activity is critical to continue to research and analyze reliability performance and proposed standards in light of changing resource mix, smart grid technologies, and integration of intermittent renewable resources



Q & A

